AGENDA
CALIFORNIA TRAFFIC CONTROL DEVICES COMMITTEE (CTCDC)

May 6, 2004 Meeting
Marin County Civic Center
3501 Civic Center Drive, San Rafael, CA 94913
TIME 9:30 AM

ORGANIZATION ITEMS

1. **Introduction**
2. **Approval of Minutes (January 22, 2004 Meeting)**
3. **Public Comments**

At this time, members of the public may comment on any item not appearing on the agenda. Matters presented under this item cannot be discussed or acted upon by the Committee at this time. For items appearing on the agenda, the public is invited to make comments at the time the item is considered by the Committee. Any person addressing the Committee will be limited to a maximum of five (5) minutes so that all interested parties have an opportunity to speak. When addressing Committee, please state your name, address, and business or organization you are representing for the record.

AGENDA ITEMS

4. **Public Hearing**

Prior to adopting rules and regulations prescribing uniform standards and specifications for all official traffic control devices placed pursuant to Section 21400 of the California Vehicle Code (CVC), the Department of Transportation is required to consult with local agencies and hold public hearings.

99-11	MUTCD Adoption by Caltrans	(Continued) (Meis)

5. **Request for Experimentation**

01-9	Proposal to Modify approved Experiment, "In-Roadway Warning Lights at R/R Crossings."	(Continued) (Meis)
00-6	Pedestrian Countdown Signal Heads (City of SF will present a final Study Report)	(Continued) (Banks)

6. **Discussion Items**

None

7. Information Items

03-6	Radar Speed Sign (Experiment Agency – City of San Jose) Status: City of San Jose planned to conduct the study next fall (October/November 2004) for the school radar signs that San Jose installed this past fall	(Borstel)

Tabled Items

02-16	Traffic Signal Warrants 1 & 2 (Footnotes were not included in the 1996 Publication)	(Continued) (Babico)

8. Next Meeting

10. Adjourn

ITEM UNDER EXPERIMENTATION

99-10 TACTILE PEDESTRIAN INDICATORS (Folkers)
(Experiment Agency-The City of Los Angeles) (Fisher)
Status: No update received.

99-12 SPEED STRIPING FOR SMART CROSSWALKS (Meis)
(Experiment Agency-Caltrans D7)
Status: No update

99-13 ILLUMINATED PAVEMENT MARKERS ON MEDIAN BARRIERS (Experiment Agency-Caltrans D7) (Meis)
Status: The project has not been funded yet.

00-1 BICYCLE PAVEMENT MARKING (Banks)
(Experiment Agency-City of San Francisco)
Status: Committee has received final study report during the January 22, 2004 meeting.

00-6 PEDESTRIAN COUNTDOWN SIGNAL HEADS (Banks)
(Experiment Agency-City of San Francisco)
Status: The City of San Francisco will present a final report during the May 6, 2004 meeting.

00-8 PEDESTRIAN COUNTDOWN SIGNAL HEAD (Tanda)
(Experiment Agency-City of San Jose)
Status: The City of San Jose has submitted the final study report during the May 2002 meeting. The Committee will make a decision during the May 6, 2004 meeting.

01-3 PEDESTRIAN COUNTDOWN SIGNAL HEADS (Fisher)
(Citywide Experiment request by the City of Fountain Valley)
Status: The City has submitted their final report to the Committee and has received approval to expand the experimentation as a citywide.

01-4 TACTILE PEDESTRIAN INDICATORE WITH AUDIBLE INFORMATION (Experiment request by the City of Santa Cruz) (Tanda)
Status: No update.

01-7 PEDESTRIAN COUNTDOWN SIGNAL HEAD (Tanda)
(Experiment Agency-City of Oakland)
Status: The city has received approval from the FHWA and working to acquire funds in the FY 2002-03 budget.

01-9 IN-ROADWAY WARNING LIGHTS AT R/R CROSSINGS (Meis)
(Experiment requests by CPUC in cooperation Kern Co. & City of Fresno)
Status: CPUC is in process to hire consultant firm to conduct a study.

02-2 PEDESTRIAN COUNTDOWN SIGNAL HEAD (Tanda)
(Experiment Agency-City of Berkeley)
Status: No update.

02-4 PEDESTRIAN COUNTDOWN SIGNAL HEADS (Larsen)

(Experiment request by the County of San Luis Obispo)
Status: No update

02-11 Speed Feedback (Radar Speed) Sign (Fisher)
(Experimentation Agency – City of Garden Grove)
Status: The City has submitted the preliminary report

02-14 Speed Feedback (Radar Speed) Sign (Mansourian)
(Experimentation Agency – County of Mendocino)
Status: A report was received from the County and forwarded on 12/18/03 to the Committee Members for review.

02-15 Radar Guided Dynamic Curve Warning System (Meis)
(Experimentation Agency – Caltrans D5)

03-1 Speed Feedback (Radar Speed) Sign (Fisher)
(Experimentation Agency – City of Whittier)

03-4 Radar Speed Sign (Borstel)
(Experiment Agency – City of Vacaville)

03-5 Radar Speed Sign (Borstel)
(Experiment Agency – City of San Mateo

03-6 Radar Speed Sign (Borstel)
(Experiment Agency – City of San Jose)
Status: City of San Jose planned to conduct the study next fall for the school radar signs that San Jose installed this past fall.

03-13 Variable Speed Limit Sign (Borstel)
(Experiment Request by the City of Campbell)

03-14 Numbering of Signalized Intersections (Babico)
(Experiment Request by the CVAG)

03-15 Radar Speed Sign (Borstel)
(Experiment Request by the City of Freemont)

STATUS OF CALTRANS ACTION ON PAST ITEMS

Item 99-3 AUDIBLE PEDESTRIAN SIGNAL POLICY
Committee will make a final decision during the May 6, 2004 meeting in regards to adoption of MUTCD 2003 along with California Supplement.

Item 01-1 U-TURN SIGNAL HEADS INDICATOR
Caltrans will develop appropriate standards to ensure visibility and make the U-turn signal head indicator an official traffic control device by inclusion in the Caltrans Traffic manual.

Item 01-6 SUPPLEMENT SIGNS ON CHANNELIZERS
Caltrans will work with the Committee on this item.

Item 00-4 USE OF RAISED PAVEMENT MARKERS IN TRANSVERSE PATTERN
Caltrans will take appropriate action on the recommendation made by the Committee.

Item 01-5 ACCESSIBLE PEDESTRIAN SIGNALS
Committee will make a final decision during the May 6, 2004 meeting in regards to adoption of MUTCD 2003 along with California Supplement.

Item 02-3 RIGHT EDGELINE
Caltrans will take appropriate action on the recommendation made by the Committee.

99-11 MUTCD Adoption by Caltrans along with California Supplement P 1-1

California Supplement to the MUTCD 2003

Caltrans requests the CTCDC to recommend the adoption of the MUTCD 2003 and the California Supplement (as posted on the Supplement web site) as the standard for all official traffic control devices, in accordance with Sections 21350 and 21400 of the California Vehicle Code.

Summary

This item was initiated at the July 22, 1999 meeting to discuss the adoption of the MUTCD for California. Since the MUTCD was undergoing a rewrite and was expected to be released by December 2000 this item was tabled. At the November 9, 2000 meeting, CTCDC was informed that Caltrans had decided to adopt the MUTCD and would provide more details in future meetings.

Over the next two years, 2001 and 2002, a section by section comparison was made between the Caltrans Traffic Manual and the MUTCD. Some other publications included in this review were Caltrans Traffic Sign Specifications, Caltrans new policies and internal memos, CTCDC's Light Rail Traffic Manual, Caltrans Highway Design Manual Chapter 1000 (Bicycles), portions of Caltrans Maintenance Manual, Caltrans Ramp Meter Design Manual and Caltrans HOV Guidelines.

Starting in early 2003, draft texts were prepared for each part of the California Supplement and submitted to CTCDC and Caltrans internal advisory committee for review. To help the review process, further discussions were held in two separate workshops held over a period of 4 days with CTCDC members in July and September, 2003. Based on these reviews, discussions and recommendations, the draft text was finalized for all parts and made available and open to the public for comment in November 2003, through the California Supplement web site. The draft text was further corrected and finalized based on the public input through the public comment period, which closed on December 31, 2003.

Although the draft text for the California Supplement to the MUTCD 2000 was completed in 2003, it was decided (at the January 22, 2004 CTCDC meeting) to adopt the MUTCD 2003 Edition (which had recently been released by FHWA) rather than the 2000 Edition. This resulted in postponing the MUTCD adoption for California to May 2004. A CTCDC workshop was held in Sacramento on March 25 and 26, 2004 to discuss the 2003 Edition changes. Based on these workshop discussions, the draft text for the California Supplement has been finalized and made available and open to the public for comment through the California Supplement web site.

For more information, see the California Supplement web site at:

http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/

01-1 Proposal to Modify approved Experiment, "In-Roadway Warning Lights at R/R Crossings." P1-8

A Description of Proposed Short Duration Modifications to an Existing Experiment

The Visual Detection Laboratory at U.C. Berkeley (VDL), on whose behalf the Kern County Roads Department is making an official request for FHWA permission for experimentation, wishes to make minor and short term modifications to an already approved and existing experiment, the *In-Roadway Flashing Lights Devices at Highway-Railroad Crossings* (Poplar Ave Crossing; Mr. Peter Lai of the CPUC—Principal Investigator). This document describes those modifications.

I. Background and Objective

Mr. Lai's project (Office of Traffic Safety funding grant) is currently running at Poplar Avenue Crossing No. 2-907.20 in Kern County, California. For record keeping, the FHWA has titled the experiment as "4-237 (Ex)-*In-Roadway Lights for Highway-Rail Grade Crossings—Kern County*." For brevity this document will simply refer to it as Mr. Lai's experiment (although technically it is requested by Kern County) or the "main" experiment.

It was inspired by the successful use of the innovative In-Pavement Flashing Lights Crosswalk Warning System to alert drivers to the presence of pedestrians in a crosswalk and is a test of whether a similar system can better alert drivers to the presence of a train approaching a railroad grade crossing.

The details are spelled out in the original application for the main experiment [Hayslett, Pagett and Lai; *Request for Experimentation: In-Roadway Flashing Lights System at Highway-Railroad Crossings* with accompanying letter to the FHWA dated September 14, 2001] but here below is a (very) brief summary.

It consists of five red LED lights embedded in the roadway (protruding less than ½ ") near the highway-railroad grade crossing. There are three amber lights ahead of them in the approach lane (figure 1). When a train approaches all the lights flash simultaneously with the timing given in figure 2.

The original request for experimentation proposed three sites in Kern County (and one in Paramount City). VDL was originally going to ask for permission to test at the Kratzmeyer/Rudd Road location but it is our understanding that that site is no longer being used for the main experiment and we wish to test at the Poplar location instead. This is the only location that we wish to test at.

The main experiment data gathering includes magnetometers to measure vehicle approach speed. These are shown in figure 1.

The contractor for this project is *Korve Engineering*. They have made the physical layout for the project at Poplar as shown in figure 1. *LightGuard, Inc.*™ is a subcontractor to *Korve* and provided the actual light heads that were embedded in the pavement and is responsible for the controller that activates the lights upon approach of a train. The light sequence that will be used in the project (the lights are not yet activated as of this writing) consists of all lights switching on or off simultaneously with the timing sequence shown in figure 2.

VDL has been conducting research into whether spatial and temporal patterns of traffic warning lights can elicit a better driver response to those lights (e.g. a faster reaction time for braking) than "straight flashing" or a "constant" light. For example our research with the light bars on the rear of buses indicates that having the bus bar turn on in segments results (on average) in a faster reaction time to that warning, even though the segmented display takes longer to fully light the bar than the "all on at once" mode.[1]

[1] **T. E. Cohn and K. M. Nguyen** (2002) *Tortoise beats the hare again: Turning on Parts of a Warning Signal with Some Delay Makes It Seen Faster*, Proceedings of the TRB Symposium on Visibility, Iowa City, Iowa; Transportation Research Board, National; Research Council, Washington, DC.

In the current context, VDL is studying (so far only in our lab) whether various spatial/temporal patterns can improve reaction time in comparison to the standard pattern (figure 2), using the same LED units from *LightGuard* in roughly the same spatial layout as in the CPUC field experiment at Poplar.

The objective behind the requested modifications is to extend these tests to the field.

The main experiment has the purpose of appraising the patterns of traffic use of the railroad crossing equipped with embedded LED signals that operate when the rail crossing flashing lights operate. In addition to driver interviews, they will be able to describe in good detail the distribution of speeds of vehicles approaching the embedded flashing signal as compared to the same distribution with no embedded signal.

Sparse traffic on Poplar make it necessary to observe traffic activity over a period of months in order to be statistically certain of the effect on the distribution of traffic speed with and without the device. One would require an additional period of experimentation of many months in order to fully compare the type of data gathered earlier with that we could gather.

Instead, we plan a very brief data gathering period. The purpose of our research is to search for the best embedded signal time pattern. Reduced to its simplest description, we plan to examine the utility of a pattern that we develop as compared to the standard offered by the vendor (figure 2). During our data gathering period of two weeks, we expect to record behavior of only several dozen vehicles. This will allow us to make a first order comparison of vehicle behavior. We will be able to compare the mean speed of approaching vehicles. We will not be able to compare entire distributions because the one that we can record in two weeks will be poorly defined. However, that datum (the mean) coupled with on-site observation of the visual effect of the signals compared to that of the standard mode, will provide enough information to complement our laboratory testing.

P 3-8

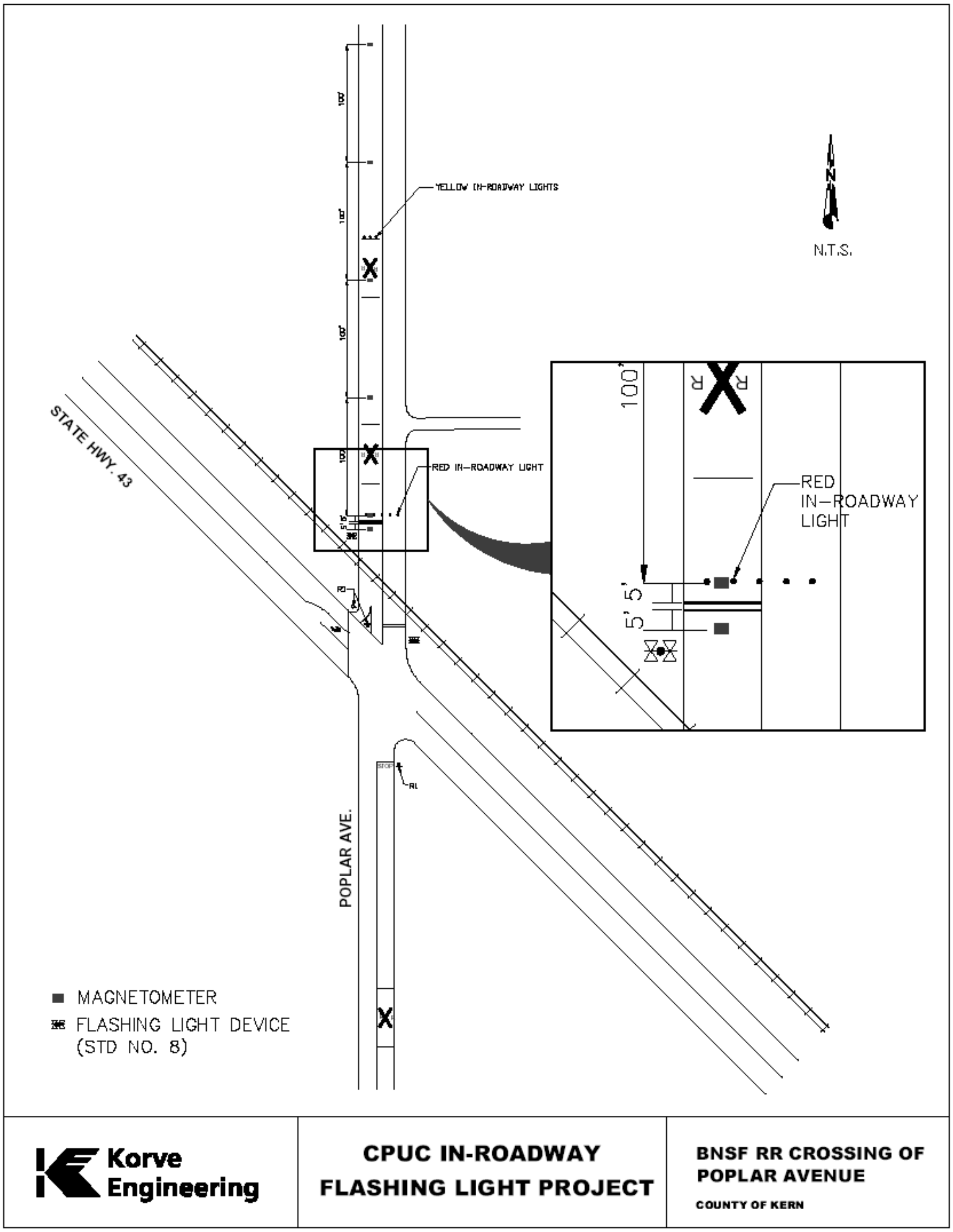

Figure 1: Physical layout of red and yellow in-pavement LEDs and sensors at the Poplar location

P 4-8

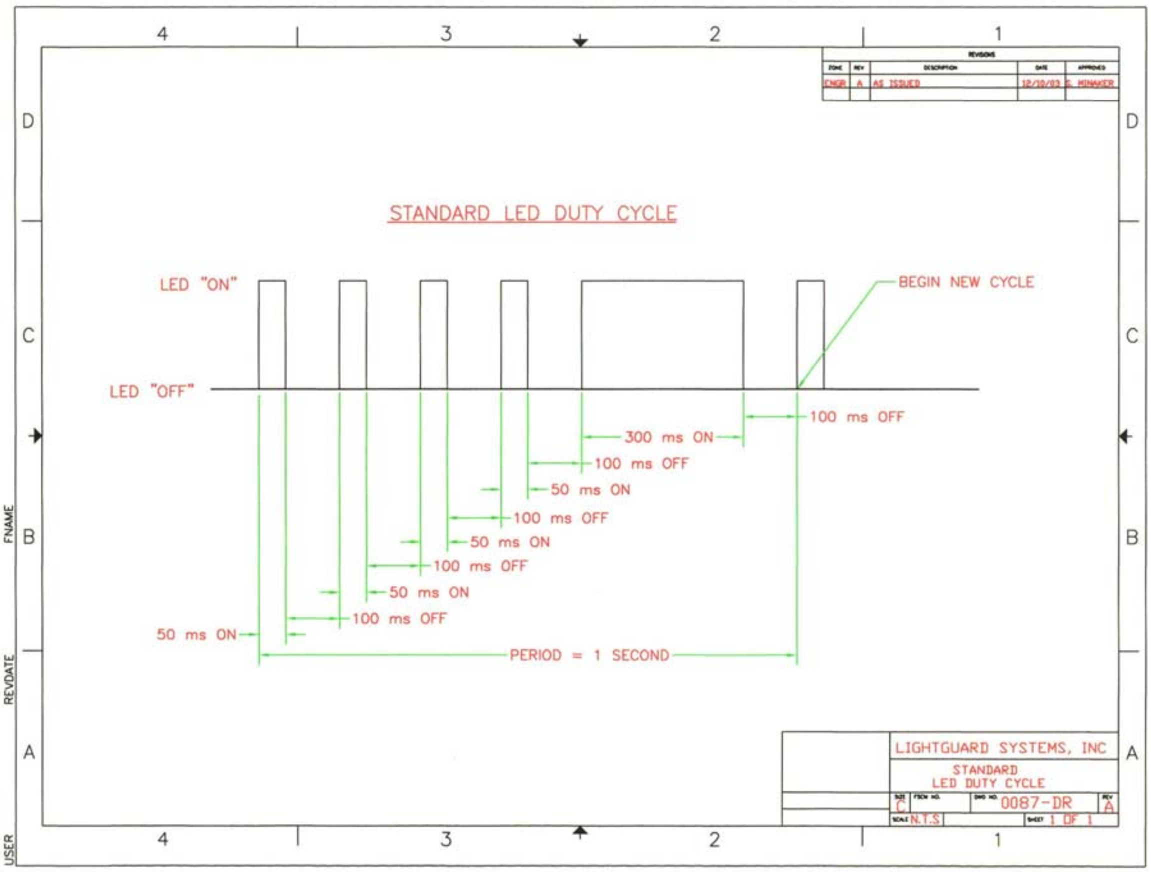

Figure 2: Standard LED duty cycle (all lights on or off together)

II. Scope [*what, where, when and how*]

99) The actual pattern that we wish to test is shown in figure 3, with each step of the sequence progressing down the figure. This is (essentially) a "wig-wag" type pattern.

The pattern starts with two lights coming on for 150 milliseconds. All lights are then off for 110 milliseconds. The remaining three lights (out of the five) that did not come on before now then come on for 150 milliseconds. All lights are then off for an additional 110 milliseconds. The cycle then repeats. Note that it is "wig-wag" because the sequence alternates between "even" and "odd" lights. In other words, if the lights are numbered 1 through 5 looking left to right, then lights 2 and 4 light up, turn off and then (after a short gap) lights 1, 3 and 5 light up. They in turn go out and are followed by a short gap, etc.

This pattern applies to the red lights only. The pattern for the amber lights will remain unaffected.

P 5-8

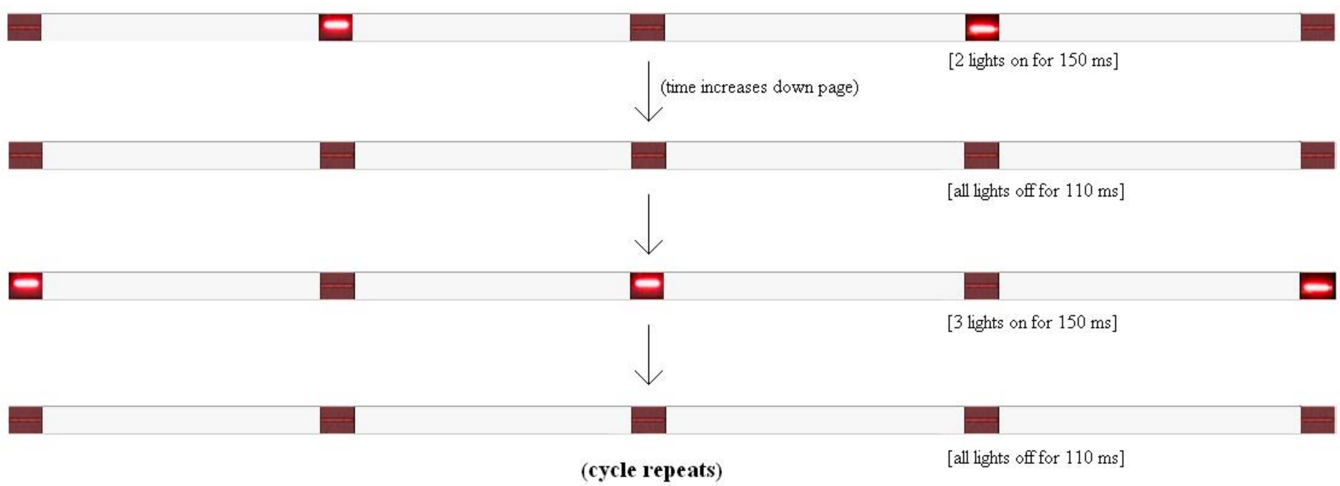

Figure 3: Proposed light pattern (time increases down the page)

The reasoning behind this choice of pattern is straightforward. When there is spatial variation to the firing pattern of a string of warning lights instead of simultaneous flashing then, provided the integrated intensity is comparable, the spatially varying sequence will usually trigger a faster response (reaction time) than will the simultaneous flashing.

There are, of course, caveats. The integrated intensity of the two patterns must be comparable. Brighter lights or more lights in one pattern could alone provoke a faster response. The challenge is to find a pattern that generates a faster response within the constraints of integrated intensity and has some of its changes (either spatial or temporal or both) occur within a "typical" reaction time.

The vision system integrates stimuli (in the sense of a transducer) in about 100 to 150 milliseconds. The standard pattern of figure 2 has all five lights on for 50 milliseconds (ms) and then all of them off for 100 ms. Thus it has 5 lights x 50 ms = 250 light-ms of integrated intensity. The pattern in figure 3 has two lights on for the first 150 ms. Hence it has 2 lights x 150 ms = 300 light-ms of integrated intensity if 150 ms is taken for the eye's integration time. If 100 ms is taken as the integration time then it has 200 light-ms. These numbers are comparable to 250 light-ms. The comparison on this basis is fair.

Both patterns also have (some of) their changes (on → off or off → on) happening within about 300 ms, a reasonable value for a "typical" reaction time (although there is much individual variation).

The choice of this particular spatial pattern in figure 3 was based on preliminary evaluation of lab work in comparison to other spatially varying patterns and the fact that such a pattern is similar (but not, of course, identical) to the "wig-wag" type pattern of the usual railroad grade crossing warning lights.

99) **The location is, of course, the same place as the current experiment is installed. This is shown in figure 4 below. It is referred to as Poplar Avenue Crossing No. 2-907.20 in the main experiment's original application.**

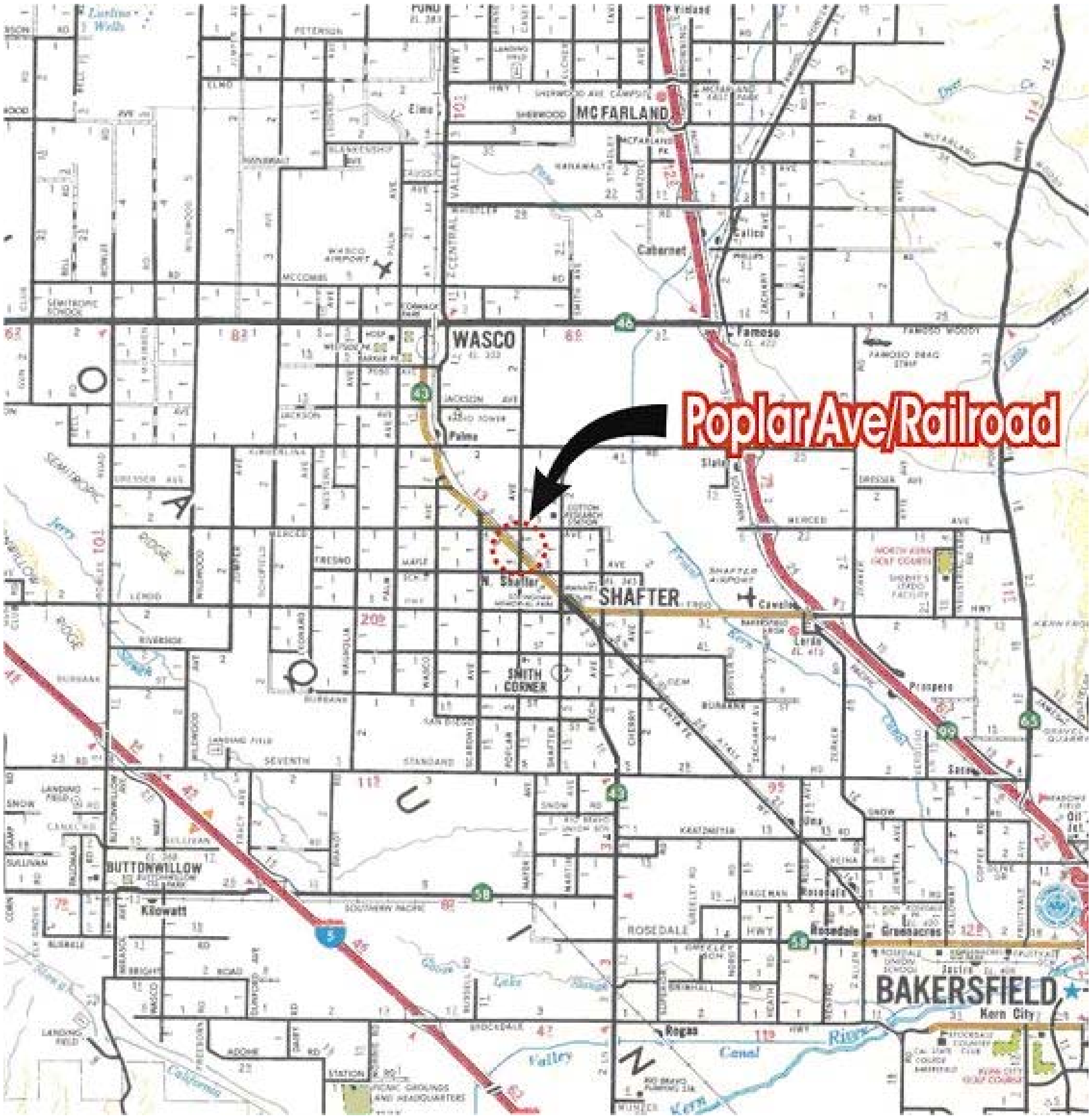

Figure 4: Map of the area surrounding the experiment

99) The currently running experiment is not yet "lit". *Korve* decided that it was easier to do all the installation at once. Thus the in-pavement lights and magnetometers (for data gathering) and control boxes were all put in at once around January 19^{th}, 2004. But a comparison "baseline" dark period where vehicle data is gathered but the in-pavement lights are switched off was desired. According to communications with *Korve* this is to last about 3 months. Thus the lights can be activated around April 19^{th}.

It is our intention to run our modification starting at activation time for two weeks, ahead of the main experiment's (approximately year long) lit period. Thus we expect to run from about April 19^{th} to May 3^{rd}.

4) The procedure to implement the changes is very straightforward. The difference between the main experiment's light pattern and the one described here is variation in

time and space. To achieve this only two things have to be changed: the wiring and the controller.

The standard pattern has all the lights come on simultaneously. The pattern proposed here has different lights come on at different times. Thus for control purposes the standard pattern can have the power wires to the lights electrically tied together (bundled) at one control point. The proposed pattern (figure 3) obviously needs control of individual lights. In this case, the power/control wires are unbundled. Since *Korve* was kind enough to accommodate our potential needs, the control/power wiring to the lights is unbundled and is accessible above ground in a wiring box. Thus wiring changes are as straightforward as bundling or unbundling the wires from the connectors in the wiring/control box.

From discussions with *LightGuard* their controller that is used to flash the standard pattern in the main experiment cannot be easily modified to accommodate our proposed pattern. Therefore we need to switch controllers but only for the length of time outlined above. After the two week run the original controller would be put back.

This alternate microcontroller is being developed in consultation with *LightGuard* and they have kindly agreed to build the actual device after checking over the design.

The data taking procedure is unaffected except for the fact that an additional two weeks worth of data will be taken in an experiment that will already be taking data for over a year. *Korve* is gathering the data from the magnetometers and VDL will pay for the additional two weeks of effort. There is a very minimal impact.

III MUTCD Regulation 4L.02 and the Proposed Pattern

In the response to the main experiment's original request of the FHWA, a reply from the FHWA specifically mentioned MUTCD regulation 4L.02. This relevant part of this regulation is reproduced below:

> 4L.02 [In-Roadway Warning Lights at Crosswalks]
>
> "The flash rate for In-Roadway Warning Lights at crosswalks shall be at least 50, but not more than 60, flash periods per minute. The flash rate shall not be between 5 and 30 flashes per second *to avoid frequencies that might cause seizures*." (italics and underline are ours)

Clearly**, the pattern in figure 3 satisfies the essential requirement of avoiding the photosensitive epileptogenic region**. There are two flashes in 520 milliseconds, which work out to a flash rate of 3.8 flashes per second.

The regulation 4L.02 did not define "period" but assuming the usual meaning of the word, it is one complete cycle of flashes that can be demarcated as a single group. In order to extend the period of figure 3 to one second (60 periods per minute) it will actually be implemented as: 2 lights on for 150 ms, no lights for 110 ms, 3 lights on for 150 ms, no lights for 110 ms, 2 lights on for 150 ms, no lights for 90 ms, 3 lights on for 150 ms, no lights for 90 ms. In other words, figure 3 almost repeats twice but the "lights off" gap in the second round is changed from 110 ms to 90 ms.

This change is insubstantial as far as visual detection is concerned (flash rate is only then up to 4 per second from 3.8) and the pattern in figure 3 remains the core of what is to be tested but this (very trivial) change will extend the period to one second in the highly unlikely case that the pattern in figure 3 exactly as it stands would not be considered *de minimis.*

It should be noted that if the above interpretation is in error, VDL believes we could easily modify the pattern in other ways (merely by reprogramming the controller) that would still (essentially) test the pattern in figure 3 and comply with 4L.02 under any reasonable interpretation.

IV Removal of Installation

The removal of our modification is very simple. After our run, the wires will be bundled (electrically tied) at the connectors in the wiring box and the original controller will be swapped back. This will leave the main experiment ready to go in its original condition.

Removal of the in-pavement lights, control box, repaving, etc. is under the purview of the main experiment and is not relevant to what we are proposing.

V Summary

We are proposing a minor and temporary modification to an already approved, existing, and underway experiment. The proposed experiment would test an alternate and possibly more effective warning light pattern than the existing main experiment while having a minimal impact on it. The data taking period for the modification would only last two weeks and would just use the same methods as are used on the main experiment. Indeed, in addition to the data taking methods, the lights themselves, the location and the deployed layout are all as in the main experiment thereby efficiently using resources.

In terms of physical changes, the modification would only require minor wiring changes at connectors in a control box (no digging up of pavement, no soldering, no running of new wires) and swapping microcontrollers. When the test period is over, the original controller will be put back and the wiring changes undone, leaving the main experiment ready to proceed as originally intended.